

## **SURGICAL RETRACTOR HAVING CURVED ARMS**

### **CLAIM OF PRIORITY**

**[0001]** This application claims the benefit of U.S. Provisional Patent Application No. 60/394,342 filed July 3, 2002.

### **BACKGROUND OF THE INVENTION**

**[0002]** The method and devices disclosed are related to procedures and products utilized in minimally invasive joint surgery, and more particularly to retractors and associated components which are utilized in minimally invasive hip surgery.

### **BRIEF DESCRIPTION OF RELATED ART**

**[0003]** Traditionally, hip surgery is an invasive procedure. Surgeons usually make large incisions and dislocate the femur at the hip. The femur is then placed across the patient's stomach while the surgeon accesses the hip area.

**[0004]** In order to shorten the recovery times, minimally invasive surgery has been proposed so that recovery times can be shortened which reduces the total costs of the procedure. In order to perform minimally invasive surgery on joints, such as the hip, new procedures and devices are necessary.

### **SUMMARY OF THE INVENTION**

**[0005]** A need exists for a retractor support apparatus and associated components as well as a method for their use in minimally invasive joint surgery, including hip surgery.

**[0006]** A need also exists for the use of a retractor assembly and associated components for use in minimally invasive joint surgery.

**[0007]** Another need exists for an improved retractor.

**[0008]** Another need exists for an improved retractor clamp.

**[0009]** Yet another need exists for an improved retractor frame.

**[00010]** Accordingly a retractor assembly includes a retractor frame having two arms extending from a rack. The two arms may be curved, straight, or angled. The arms may also be hinged. At least one, and possibly both of the arms are locatable relative to the rack. Instead of being straight as has been traditionally done, the rack may be curved such as to define an arc of a circle, or having a changing radius such as a segment of a french curve.

**[00011]** Retractor clamps are utilized with the frame and may be connected to either the arms or the rack itself. Some retractor clamps are adapted to fit slide into position and need not necessarily have any other connecting mechanism to secure the clamp to the arm or rack. Other clamps have a retaining clip which may be spring biased to hold the clamp in a desired location on the arm or rack. Some clamps maintain a mount in a fixed position. Other clamps have mounts which are pivotable relative to their connection on the arm or rack. The rack or other portion of the system may then be connected to a bed rail or vertical post connected to the operating table or other fixture to fixedly secure the position of the retractor system components. The pivoting feature allows the mount to lift or push retractor blades into or out of an incision. The retractor clamps may be connected to a retractor handle and then to a blade. When the tissue is retracted to a desired position, the clamp is then secured to an arm or rack. The handle may then be disconnected from the blade.

**[00012]** Additionally, an extension arm is illustrated connected to an arm. The extension arm allows for substantially three hundred and sixty degrees of capability of positioning retractor clamps about an incision.

## BRIEF DESCRIPTION OF THE DRAWINGS

[00013] The particular features and advantages of the invention as well as other objects will become apparent from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a top plan view of a retractor frame of a presently preferred embodiment of the present invention;

Fig. 2. is a top plan view of a first alternatively preferred embodiment of the retractor frame of the present invention;

Fig. 3a is a top plan view of a second alternatively preferred embodiment of the retractor frame of the present invention with two retractor clamps connected thereto;

Fig. 3b is a back side plan view of the rack used in the retractor frame of Figure 3a;

Fig. 4a is a top plan view of a third alternatively preferred embodiment of the retractor frame of the present invention with an extension arm connected thereto;

Fig. 4a is a side perspective view of the extension arm shown in Figure 4a;

Fig. 5 is top plan view of a fourth alternatively preferred embodiment of the retractor frame of the present invention;

Fig. 6 is a side plan view of an arm of the fourth alternatively preferred embodiment in an unlocked position;

Fig. 7 is a side plan view of a preferred retractor clamp of the present invention;

Fig. 8 is a side plan view of the retractor clamp of Fig. 7 with the mount pivoted downwardly;

Fig. 9 is a side plan view of the retractor clamp of Fig. 7 with the mount pivoted upwardly;

Fig. 10 is a top plan view of the retractor clamp of Fig. 7.

Fig. 11 is a side plan view of a first alternatively preferred retractor clamp of the present invention;

Fig. 12 is a side plan view of a second alternatively preferred retractor clamp of the present invention;

Fig. 13 is a top plan view of the retractor clamp of Fig. 12;

Fig. 14 is a side plan view of a retractor blade for use in the present invention;

Fig. 15 is a top plan view of the retractor blade end shown in Figure 14.

Fig. 16 is top plan view of an alternatively preferred retractor blade end.

Fig. 17 is a side plan view of the retractor blade end of Fig. 16;

Fig. 18 is a side plan view of a handle for use with the retractor blades of Fig. 15-17. and

Fig. 19 is a perspective view of a surgical retractor system in use.

#### DETAILED DESCRIPTION OF THE DRAWINGS

[00014] Accordingly, Figure 1-17 show a plurality of embodiments of the devices used with minimally invasive joint surgery. Figure 1 shows a retractor frame 10 having a curved rack 12 or cross member. Racks of traditional frames are not believed to have been curved structures, however the curved rack 12 has been found helpful in applications such as joint surgery since the distal portion 14 of the rack 12 is further from the first arm 18 than the proximal portion 16. In a properly designed frame 10, the distal portion 14 will be out of the surgeon's way so that he or she can access the incision between the arms 18,20.

[00015] Another feature believed to be novel is the provision of two adjustment housings 22,24 which are slidably mounted relative to the rack 12 with each housing 22,24 respectively connected to the arms 18,20. This feature is believed to be helpful so that the rack 12 which is not intermediate

the housings 22,24 may be positioned so that is opposite the surgeon, or otherwise located out of the way.

[00016] In Figure 2, frame 30 is illustrated with rack 32 having a first and second arcs 34,36 which would have two different radii. In other embodiments, the radii could be continuously changing such as provided by a french curve and/or include more distinct radii sections. This may assist in providing a desired angular relationship between the arms 38,40 for some surgical procedures at a desired spacing.

[00017] As can be seen by examining figures 1 and 2, the arms 18,20 and 38,40 are not parallel. While the arms 18,20 and 38,40 could be parallel in some embodiments, such as shown in Figure 4, the non-parallel nature of these arms is believed to be new to the art when straight arms are utilized. Additionally, as shown in Figure 2, the angular relationship between the arms 38,40 can be varied based on where on the rack 32 the arms 38,40 are positioned, especially if each arm 38,40 has a housing 42 connected thereto to allow movement of the both arms 38,40 relative to the rack 32. As can be seen in Figure 1, the angle between first and second axes 26,28 is about 15 degrees. Depending on the spacing between the housing for a fixed radius arc segment of rack 12, the angle will vary with the spacing.

[00018] In Figure 2, since the rack has multiple radii arc segments, the angle between first and second axes 44,46 is not solely dependent upon spacing between the arms 38,40. While the three axes 44,46,48 are substantially equally spaced from one another where they intersect the rack 32, the angle between the first and second axes 44,46 while the angle between the second and third axes 46,48 is about forty five degrees. In other embodiments, the radii of arc segments may be different

which of course would affect the angular relationship of the arms 38,40 as the spacing between the arms is increased or decreased.

[00019] Of course, housings may be designed or provided that allow for the arms 38,40 to be maintained parallel to the rack 32 through the changes in radii or for a specific radii by providing a connection of the arms at the housing allowing rotational movement of the arm relative to the housing or otherwise.

[00020] Figure 3a shows an alternatively preferred embodiment of the preferred invention which shows some of the versatility of the retractor system described herein. Retractor 50 has a fixed arm 52 and a moveable arm 54. Unlike the hinged and straight arms shown in Figures 1 and 2, the arms 52,54 are curved along their length. This structure is believed to assist for certain shaped incisions. The rate of curvature may vary along the length, however the embodiment shown shows a relatively constant rate of curvature. The rack 56 may be substantially linear as illustrated, or could be curved as shown in Figures 1, 2 and 3b. The arms 52,54 as well as the rack 56 may be provided with retractor clamps 58,60. Although the clamps are shown on the first arm 52, they may also be placed on the second arm 54 or the rack 56. The arms 52,54 may either have a smooth back 62, or a scalloped back 64 depending upon the needs of the user and the particular components to be utilized with the retractor frame 50. Of course, some racks 56 can be dome shaped or curved as shown in Figure 3b as well as curved as shown in Figures 1 and 2 so that they are curved in more than two dimensions. The "doming" of the rack 56 has been found helpful in getting the ends 57,59 out of a surgeon's way in some procedures.

[00021] Figures 4a and 4b has been provided to illustrate a particular accessory for use with retractor frames, such as with a traditional frame 70 or any of the improved frames shown in Figures

1-3 or others. The extension arm 72 is believed to be a new development in the field of components utilized with retractor frames 70. The extension arm 72 may provide a surgeon the ability to provide substantially 360 degree coverage about an incision for locations to place a retractor clamp, and thus direct a retractor into an incision. This flexibility provides the surgeon with numerous options to provide a retracted incision while minimizing any impediments to his vision or ability to work within the incision.

[00022] Depending on the needs of the surgeon, the extension arm 72 may be substantially planar with the arms or it may elevate a support surface 74 above the arm, illustrated as first arm 76 it is connected so that the support surface 74 may pass over, or under, the second arm, such as second arm 78. Of course the extension arm 72 may be connected to the second arm 78 instead of the first arm 76 as illustrated. Additionally, the extension arm 72 may be equipped with a housing 80 which may either secure the extension arm 72 to an arm 76,78 or it may be somewhat similarly constructed as the housing 82 on either the first or second arms 76,78 to allow the surgeon or assistant to retract tissue away from the rack 84. Additionally, the extension 74 is illustrated as having a curved and/or domed support surface 74, however it could be straight, angled or otherwise constructed such as in a manner illustrated for the racks and arms shown herein. The use of the extension arm 74 is believed to be a huge improvement over the technique shown in U.S. Patent No. 5,795,291, incorporated by reference, which requires using two retractor frames. Furthermore, the system utilized may be secured to a fixed support such as a vertical post 300, a rail of an operating table or other appropriate location as shown in Figure 19.

[00023] Figures 5 and 6 show other features which may be incorporated into retractor frame construction for minimally invasive joint surgery. Frame 90 is illustrated having a rack 92 with arms

94,96 connected thereto. Housings 98,100 allow either of the arms 94,96 to be moved relative to the rack 92. The arms 94,96 have intermediate segments 102,104 which are angled relative to first and second end segments 106,108 and 110,112, respectively. The first and second end segments 106,110 and 108,112 are parallel to one another, respectively.

[00024] From Figure 6, the geometry of the arms 94,96 can be seen as being substantially rectangular except where the first segment 110 connects with housing 100. Although other geometrical arrangements can be utilized, in the embodiment shown in Figures 5 and 6, the first segment 110 is substantially round at base 114. The base 114 has serrated surface 116 which cooperates with serrated surface 118 on housing 100. Locking lever 120 locks and unlocks the first segment 110 relative to the housing 100.

[00025] The first segment 110 is illustrated as being rotatable relative to the housing 100 so that retractors may be positioned down into a wound or elevated relative to the wound when the first segment is in an unlocked configuration as shown in Figure 6. This feature is also believed to be useful with racks which are dome shaped as shown in Figure 3b to provide a desired angle of the arms relative to the rack (for instance, the planes the arms are in may be made to be parallel to one another even though the rack is not linear in some embodiments). By locking the first segment 110, the serrated surfaces 116,118 are brought into contact with one another to fix the rotational position of the arm 110 relative to the housing 110. The lever 120 is operably connected to a cam (obscured from view) within the first segment 110 which cooperates with post 122 to move the first segment 110 relative to the housing 110. Of course, there are other ways known in the art wherein the first segment 110, or a portion of the first segment 110 may be rotatably positioned relative to axis 124 and then secured at a desired position.



**[00026]** The first arm **94** is illustrated as having a similar angular adjustment feature as the second arm **96** which has been described in detail above. While this embodiment has hinged arms defined by segments **106,102,108** and **110,104,112**, the arms of Figures 1 - 4 could also be provided with this capability.

**[00027]** The interior workings of the housing **100** are also illustrated in Figure 6. While other devices are known in the art, the housing **100** has a driver **126** actuated by a handle **128**. The driver **126** illustrated is a wheel with spokes **130** adapted to fit within slots **132** shown in Figure 5. Release lever **134** may act allow the driver **126** to act as a ratchet to move in only one direction when in the normally biased position illustrated, or it may be depressed to disengage the driver **126** from the slots **132** to allow the arm **96** to be positioned at the will of the user of the rack **92**.

**[00028]** Referring back to Figure 3, two clamps **58,60**, are illustrated. Details of these clamps and others are shown in Figures 7-13. Figure 7 shows a side plan view of a clamp **140** which has a release button **142** for removing the clamp **140** once installed as shown in Figure 3. The button acts on latch **144** about pivot **146**. The latch **144** is normally biased by spring **148** into engagement with a back side **62** of an arm **52**. While clamps have only been shown in Figure 3, the same clamps could be utilized with any of the embodiments illustrated on any of the arms or racks.

**[00029]** The clamp **140** has a slot **150** which receives an arm or a rack therein. The latch **144** retains the inserted frame part. The slot **150** is illustrated as defined between upper and lower surfaces **152,154**. The upper and lower surfaces **152,154** are illustrated as parallel to one another. The clamp has a mount **156** which connects to the member **158** containing the slot **150**. The mount **156** of this embodiment is moveable relative to the member **158**. This feature is not provided in the clamps shown in Figures 11-13.

[00030] In the clamp 140 of Figures 7-10, the mount 156 is connected to or more preferably a part of leg 160. Leg 160 is operably coupled to the member 158 by pivot 162. Figure 7 shows the leg 160 substantially parallel to the slot 150. In order to change the angle of the leg 160 relative to the slot 150, operator 164 is utilized. By twisting on operator 164, threads at distal end 166 pass through nut 168 which is then moved along the axis of rotation of the operator 164. As the nut 168 moves, it acts against projections 170,172 to either pivot the leg downwardly as shown in Figure 8, or upwardly as shown in Figure 9. Of course, there are cutout portions in the projections 170,172 and leg 160 which receive the distal end 166 of the operator 164 to allow for this positioning.

[00031] Should a user desire to rapidly change the angle of the mount 156 relative to the slot 150, a quick release button 174 can be pushed which disengages threaded gear 176 to release the operator 164. Releasing the button 174 re-engages the gear 176 with the operator 164 to allow for continued adjustment with the operator 164.

[00032] Figure 10 shows a top plan view of the clamp 140. Groove 178 provides access to the mount from a hand held gripper which is illustrated in Figure 18. When using a retractor blade equipped with a head as shown in Figure 14, the head may extend up into the mount 156 where it is held by the hand held gripper and then the retractor is pulled or pushed into a desired location where the clamp may then be connected to an arm or rack and the hand held gripper may then release the clamp.

[00033] Figure 11 shows an alternatively preferred embodiment of a clamp 180 which lacks the pivotal capability of the mount 182 and leg 184 relative to the slot 186. Apart from this difference, the clamps 140 and 180 are very similar. The top view of the clamp 180 will be very similar to that shown in Figure 10 without the operator 164 extending as shown.

[00034] Figure 12 shows another clamp **190** which slides onto an end of an arm or rack of a frame. The top view of the retractor clamp **190** of Figure 12 is shown in Figure 13. This clamp may either remain moveable along the arm or rack or may be outfitted with a connector such as shown on the extension arm in Figure 4a or otherwise to secure the clamp **190** at a desired location relative to an arm or rack.

[00035] Figure 14 shows a retractor blade **200** which has a head **202** and a contact surface **204**. Although the contact surface **204** is illustrated as a "Hohmann" contact surface which is shown in detail in Figure 15, Figures 16 -17 show a "Hayes" contact surface. Of course other retractor blade contact surfaces which resemble paddles or other structures may also provide a contact surface for various uses. The head **202** may take on a number of shapes and is adapted to work with the selected mount of the clamp which will be utilized to retain the retractor blade.

[00036] Figure 18 shows a hand held gripper **210**. The gripper **210** has a handle **212** which twists relative to a shoe **214**. As the handle **212** is twisted, a post **218** extends into a bore in the shoe **214** and onto a top of a head **202** of an inserted retractor blade **200** to secure the blade relative to the gripper **210**. The head **202** has previously been inserted into slot **216** in the gripper **210**. In order to release the head **202**, the handle **212** is twisted in an opposite direction and the head **202** is released by the post **218**. The head **202** may then be slid out of slot **216**.

[00037] Numerous alternations of the structure herein disclosed will suggest themselves to those skilled in the art. However, it is to be understood that the present disclosure relates to the preferred embodiment of the invention which is for purposes of illustration only and not to be construed as a limitation of the invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.